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HIGH SOLIDS CLOSED-LOOP PRESSURE
WASHER SYSTEM

INVENTORS: GEORGE HAY

A Citizen of the United States of America

ASSIGNEE: EZ ENVIRONMENTAL SOLUTIONS
CORPORATION
3345 EDISON WAY
MENLO PARK, CA 94025

A California Corporation

BEYER WEAVER & THOMAS, LLP
P.O. Box 778
Berkeley, CA 94704-0778
Telephone (510) 843-6200

HIGH SOLIDS CLOSED-LOOP PRESSURE WASHER SYSTEM

Invented By:

GEORGE HAY

BACKGROUND OF THE INVENTION

1. Field of Invention

5 The present invention relates generally to pressure washer apparatus, and more particularly, to methods and apparatus for separating and containing higher and lower-density from contaminated washing fluids for use in the pressure washing system.

2. Description of the Relevant Art

10 Contamination of the environment by man-made substances has been considered a serious world-wide problem. Recently, concern about contamination of earth, air, and groundwater by oil, toxic chemicals, and other hazardous wastes has expanded beyond large-scale industry to encompass the activities of many small businesses including automobile service stations, and many others. Both government regulations
15 and social outcry have placed tremendous pressure on these businesses to avoid discharging hazardous wastes into the environment in the course of ordinary business activities.

Many businesses partake in activities which are likely to produce waste which may be
20 harmful to the environment. For example, in an automobile service station, washing or steam-cleaning auto parts, *e.g.*, an automobile engine, often causes engine oil, gasoline, and other chemicals to enter a storm drain system, or other waterways, thereby leading to the potential contamination of groundwater. In addition, those who service remotely located equipment generally have a need to wash the equipment
25 without discharging hazardous waste into the environment. By way of example, persons who service roof-mounted air conditioners that contain lubricating petrochemicals, trapped pollutants, or other chemicals are not permitted to wash the equipment in a manner that could cause chemicals to run off the roof and into the surrounding environment.

To address these concerns, portable, closed-loop pressure washing equipment has become widely available which may recover oil, chemicals, and other hazardous materials from an object which is being washed. These pressure wash assemblies
5 may efficiently recirculate, heat, and repeatedly filter a washing agent to minimize the quantity of waste material produced during a washing process. Typical of such systems are disclosed in U.S. Patent Nos.: 5,673,715; 5,785,067 and 5,803,982, incorporated herein by reference.

10 These zero-discharge, closed-loop wash apparatus typically deploy a multi-step contaminant removal process designed to independently separate the heavier weight or higher density contaminants, relative to the density of the washing fluid, as well as separate the lighter weight or lower density contaminants from the washing agent. A collection basin of the wash apparatus, for example, may be configured to remove the
15 heavier weight contaminants through the application of filtration baskets or through sediment settling of the coarser heavier sediments along the bottom of the collection basin. The medium weight or medium density contaminants, on the other hand, may remain suspended in the washing fluid, where they may be removed by filtration through micron filters or the like. In some designs, a succession of micron filters may
20 be used to remove successively smaller particulates and molecules from the washing agent.

Typically, these portable pressure washing systems include a load bearing support mechanism which supports the object designated for cleaning above the collection
25 basin. Often, these support mechanism include a porous grate device which enables the run-off wash fluids to flow easily therethrough directly into the collection below. While this grate material has adequate strength for small to medium weight objects, such a surface cannot be utilized for larger and heavier objects designated for cleaning, such as large earth moving vehicles. In this instance the support mechanism
30 requires substantially solid metallic plate members sufficiently thick to carrying the bulk weight object.

While these solid surfaces provided excellent weight bearing properties, silting from the run-off wash fluid often occurs, especially when larger, coarser particulates or

large volumes of contaminants are initially highly abundant. This is especially true with large earth moving vehicles containing significant amounts of solids build-up accumulated during normal operation. Upon washing these vehicle, the heavy solids, sludge and collective silt build-up on the washing surface. This is quite problematic in that it often requires extensive manual cleanup or a prolonged cleanup time after the equipment has been washed. More conventional closed-loop systems typically employ some type of fluid filtration system which are inadequate for high solids run-off. These conventional filtration systems become overwhelmed, and are either clogged or require frequent filter cleaning or replacement, since these systems were not designed to accommodate such capacity. Accordingly, it would be desirable to provide a closed-loop washing system that can accommodate the removal of such high solids contaminants run-off.

SUMMARY OF THE INVENTION

The present invention relates to a closed-loop pressure washing system adapted for removal and recovery of high solids contaminants from an object. The washing system includes a support platform having a support surface adapted to support the object while a washing fluid is flowed over the object to remove the high solids contaminant. A collection device is provided in flow communication with the support surface, and is adapted to collect and channel the run-off washing fluid and run-off high solids contaminant from the support surface towards a collection basin. A high solids separation assembly is in flow communication with the collection basin, and is adapted to separate and displace the collected high solid contaminants from the collected run-off fluids in the collection basin to a discard region spaced-apart from the collection basin. This separation assembly, however, substantially maintains the run-off washing fluid in the collection basin. The washing system further includes a clarifying reservoir in flow communication with the collection basin, and is configured to hold the run-off fluid therein for reuse back to the washing system.

Accordingly, in a closed-loop washing system where high-solid contaminants removal is substantial, the separation assembly is capable of high solids waste removal to a remove site while retaining the run-off washing fluids for collection in a clarifying reservoir and/or filtering for reuse back in to the washing system. Such capacity of solid contaminants removal is highly desirable, especially when run-off high solids

contaminant is initially abundant. As mentioned, conventional closed-loop washing systems are not capable of such high-solids removal, and often overwhelm the capacity thereof.

5 In one embodiment, the separation assembly includes a drag conveyor device having a separation station thereof immersed in the slurry of run-off washing fluid and high solids deposited in the collection basin and adapted to separate a portion of the deposited high solid contaminants from the slurry. The separation assembly further includes a discarding station spaced-apart from, and at a vertical elevation above the
10 separation station. The discarding station is adapted to discard the collected portion of the deposited high solid contaminants from the drag conveyor. Preferably, the drag conveyor includes a continuous chain member extending between the separation station and the discarding station, and having a plurality of drag weirs spaced-apart along the chain member, each the drag weir being adapted to separate and drag the
15 portion of the deposited high solid contaminants at the separation station and deposit the portion of the deposited high solid contaminants at the discarding station. The discarding assembly includes a sleeve member substantially enclosing the chain member and drag weirs in a manner enabling the collected run-off fluid in the collection basin to filter between the sleeve and the drag weirs.

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In another specific configuration, the collecting device includes an elongated receiving channel in flow communication with the support surface, and a delivery portion in flow communication with the collection basin. In this manner, the run-off washing fluid and run-off high solids contaminant collected from the support surface
25 are substantially flowed to the collection basin. The collecting device preferably further includes an auger member rotatably mounted and positioned in the channel in a manner causing the collected run-off washing fluid and run-off high solids contaminant to move from the elongated receiving channel to the delivery portion thereof for delivery to the collection basin. Further, the elongated channel is
30 positioned adjacent an edge of the support surface, and the support surface is shaped for gravity flow of the run-off washing fluid and run-off high solids contaminant toward the channel.

In still another arrangement, the washing system includes a flush assembly having one portion fluidly coupled to the clarifying reservoir, and another portion fluidly coupled to one end of the elongated channel to flush the run-off fluid and high solids contaminant toward the delivery portion thereof. Further, the washing system may include a high capacity fluid cannon coupled to the clarifying reservoir. The fluid cannon includes a nozzle member and a fluid cannon pump device configured to eject the stored fluids at a substantial capacity and rate. This rate is preferably in the range of about 40 gal/min to about 80 gal/min.

Another embodiment illustrates that the clarifying reservoir includes a plurality of baffles aligned in a manner to encourage the deposition of light solids from the collected run-off fluids as it flows therethrough. This is performed by providing an array of baffles in the clarifying reservoir wherein the deposited fluids pass through the baffles, causing the light solids to be excreted therefrom

In another aspect of the present invention, a high load capacity closed-loop washing system is provided for the support of and contaminant removal from a substantially heavy load object. The washing system includes a support platform for supporting the heavy load object having a fluid impervious upstanding peripheral side walls and a fluid impervious support surface extending atop the peripheral side walls to collectively define an enclosed interior cavity therein. The support platform includes a flowable support material curable into a relatively low density, high compressive strength material support enabling vertical support the heavy load object atop the support surface while a washing fluid is flowed over the object to remove the high solids contaminant. A collection device is in flow communication with the support surface, and is adapted to collect the slurry of run-off washing fluid and run-off high solids contaminant from the support surface in a collection basin. The washing system further includes a clarifying reservoir in flow communication with the collection basin, and is configured to store run-off fluid therein for reuse back to the washing system.

Thus, washing system provides a high compression-strength support platform which is relatively light weight. Thus, the curable core enables fabrication in any flowable shape, while providing an excellent compressive strength-to-weight ratio.

In one specific embodiment, the high compressive strength material is provided by a high strength cellular material, such as a foamed concrete. Thus, the concrete is easily flowed into the interior cavity similar to molding techniques.

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BRIEF DESCRIPTION OF THE DRAWINGS

The assembly of the present invention has other objects and features of advantage which will be more readily apparent from the following description of the Detailed Description of the Embodiments and the appended claims, when taken in conjunction with the accompanying drawings, in which:

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FIGURE 1 is a top perspective view of a pressure washing system constructed in accordance with the present invention.

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FIGURE 2 is an enlarged side elevation view of the pressure washing system of FIGURE 1 illustrating a solid contaminant separation assembly.

FIGURE 3 is a fragmentary, top plan view, partially broken-away, of the pressure washing system of FIGURE 1.

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FIGURE 4 is a fragmentary, enlarged side elevation view, partially broken-away, of the solid contaminant separation assembly of FIGURE 2.

FIGURE 5 is another enlarged side elevation view, partially broken-away, of the solid contaminant separation assembly of FIGURE 2 showing the drag weirs and chain drive componentry thereof.

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FIGURE 6 is a fragmentary, enlarged top perspective view, partially broken-away, of the pressure washing system of FIGURE 1 illustrating fluid coupling to a clarifying reservoir.

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FIGURE 7 is an exploded, top perspective view of a support platform of the pressure washing system of FIGURE 1 constructed in accordance with the present invention.

FIGURE 8 is an enlarged, side elevation view, in cross-section, of the support platform of FIGURE 7.

5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the present invention will be described with reference to a few specific embodiments, the description is illustrative of the invention and is not to be construed as limiting the invention. Various modifications to the present invention can be made to the preferred embodiments by those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims. It will be noted here that for a better understanding, like components are designated by like reference numerals throughout the various figures.

Attention is now directed to FIGURES 1-3, where a closed-loop pressure washing system, generally designated 20, is provided for removal and recovery of high solids contaminants from an object to be cleaned. The washing system includes a support platform 21 having a support surface 22 adapted to support the object while a washing fluid is flowed over the object to remove the high solids contaminant therefrom. A collection device 23 is provided in flow communication with the support surface 22, and is adapted to collect and channel the run-off washing fluid and the run-off high solids contaminant from the support surface towards a collection basin 25. A separation assembly, generally designated 26, is in flow communication with the collection basin 25, and is adapted to separate and displace the heavier-density or weight solid contaminants (i.e., mud, rocks, sludge, etc.) from a slurry of collected run-off washing fluids and the run-off high solid contaminants in the collection basin 25 to a discard region 27 spaced-apart from the collection basin. This separation assembly 26, however, substantially maintains the run-off washing fluid with the lighter and medium density or weight contaminants in the collection basin 25. The washing system 20 further includes a clarifying reservoir 28 in flow communication with the collection basin 25, and is configured to contain the run-off washing fluid therein for reuse back to the washing system.

Accordingly, unlike the filtration systems of conventional closed-loop washing systems, the separation assembly is capable of high solids waste removal and

transport to a remove site while retaining the run-off washing fluids for collection in a clarifying reservoir. During periods of high solids waste removal, the present invention enables the remaining run-off washing fluid to pass through the usual filtering devices without overwhelming these filtering systems.

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Briefly, it will be understood that the term “washing fluid” is applied to a washing agent used to wash contaminants from the surface of an object. For instance, water is the most typical washing agent, but may further include cleansing additives such as detergents, soda ash, etc. Moreover, the terms “lower-density contaminants” or “light weight contaminants” are referred to as contaminants with a specific gravity less than that of the washing fluid. Thus, the light weight contaminants naturally separate and float to the surface of the collected washing fluid. Such contaminants may include oil, gasoline, foams, plastics, ash, etc. In contrast, it will be understood that the terms “heavier-density contaminants” or “heavy weight contaminants” are referred to as contaminants with a specific gravity greater than that of the washing fluid. Finally, “medium-density contaminants” or “medium weight contaminants” are referred to as contaminants with a specific gravity similar to that of the washing fluid which may be suspended therein. All three weight contaminants will be included, in various proportions, in the run-off high solids contaminant washed off these large earth moving vehicles.

The closed-loop pressure washing system 20 includes a clarifying reservoir 28 (FIGURES 1 and 6) which, as mentioned, facilitates further separation of the light weight and heavy weight contaminants and larger medium weight contaminants from the run-off washing fluid to produce a semi-filtered washing fluid for use with a fluid or water cannon 30, and/or a more refined filtered rinsing fluid for use with a pressure washer 31. Briefly, as will be described herein, the water cannon 30 is capable of ejecting, at relatively high speeds and pressures, large volumes of the semi-filtered washing fluid for the high solids contaminant removal from a heavily soiled vehicle. In contrast, the pressure washer is applied more for final cleaning of the vehicle after the coarse washing.

Referring to FIGURES 1, 3 and 7, the washing system 20 includes the heavy duty support platform 21 that is suitably designed to vertically support large earth moving

vehicles weighing in the range of about 15 tons to about 60 tons. Briefly, as will be described in greater detail below, the support platform 21 includes a support surface 22 that is positioned atop support frame assembly 32 thereof. As illustrated, a pair of end ramps 33, 33' may be provided to enable very large, heavy equipment such as loaders, trucks, tractors, etc. to be driven or moved on and off the support surface 22. The washing system 20 may also include optional upstanding splash walls 35 to contain splashing and the like during the washing process.

Once the initial coarse cleaning of an object atop the support surface 22 has commenced using the water cannon 30, depending upon the quantity of solid contaminants removed, silting or settle contaminant buildup can occur. When such buildup is directly on the load bearing support surface 22, the water cannon nozzle can be employed in a hose-like manner to manually spray or flush the solids from the support surface 22 toward the collection device 23.

The support surface 22 is substantially rectangular-shaped having an upper elevation side and an opposite lower elevation side to facilitate run-off toward the collection device 23 located along the edge of the opposite lower elevation side. Preferably, the support surface is gradually sloped or graded toward the collection device 23 in the range of about 1° to about 4°. Moreover, as best viewed in FIGURE 1, the two outer platform portions 36, 36' of the support surface 22 may be sloped gradually inward toward a central platform portion 37 of the support surface 22 (i.e., V-shaped) to facilitate flow of the run-off toward the central platform portion 37 and into the collection device. It will be understood, however, that the floor of the support surface may be substantially V-shaped extending from one ramp to the opposite ramp thereof (not shown). At the basin or valley of the V-shaped support surface is the elongated collection device 23 spanning the support floor from one end to the opposite end thereof. In this V-shaped arrangement, the collection device separates the support surface into a pair of opposed sloped surface portions

In accordance with the present invention, the collection device 23 includes an elongated receiving portion or receiving channel 38 thereof in flow communication with the support surface 22, and having a delivery portion 40 in flow communication with the collection basin 25. As shown in FIGURES 1, 3 and 4, the elongated

receiving channel extending longitudinally along the edge of the lower side of the support surface enabling the run-off washing fluid and the flushed solid contaminants to be collected in the receiving channel. As the run-off collected solids are captured in the elongated receiving channel 38, the flow is directed toward the collection basin, via the delivery portion 40.

During periods of high solids contaminant removal from the objects being cleaned atop the support surface 22, the buildup of the removed solid contaminants can be flushed into the elongated receiving channel 38 (via the cannon). The high density solid contaminants then tend to build-up and congregate at the bottom of the channel, while the lighter weight and medium weight contaminant (suspended in the run-off washing fluid) flow toward the collection basin 25. Eventually, the buildup of the higher density solid contaminants will block flow any fluids in the channel, and cause flooding onto the support surface. Accordingly, a transport device, generally designated 41, is provided that cooperates with the receiving channel 38 to transport the deposited solid contaminants in the channel toward the collection basin 25. In this manner, the run-off washing fluid and run-off high solids contaminant collected from the support surface are substantially flowed and/or transported to the collection basin for further handling by the separation assembly 26.

As best viewed in FIGURE 3, the transport device 41 includes an elongated auger member 42 positioned longitudinally in the receiving channel 38, and rotatably mounted to a drive mechanism 43. As the drive mechanism 43 rotates the auger member 42 about its longitudinal axis in the receiving channel 38, the deposited high density solid contaminants are moved longitudinally along the receiving channel 38, and through the delivery portion 40 of the collection device 23 into the collection basin 25. To perpetuate movement toward the collection basin 25, the auger member 42 includes a rotating, elongated shaft having helical blades 45 which extend radially outward therefrom. These blades 45 extend longitudinally along the shaft from an upstream end of the channel, to an the opposite end where the blades terminate at the collection basin 25. These blades are oriented and configured to cooperate with the direction of rotation of the shaft to move the solid contaminants toward the collection basin. Upon contact of the deposited high density solid contaminants with the helical blades 45, wrapping around the shaft 46, the contaminants are urged longitudinally

along the channel until they are deposited in the collection basin 25 forming a slurry of the run-off washing fluid and the high density solid contaminants.

5 To accommodate the circular cross-sectional dimension of the helical blades, the transverse cross-sectional dimension of the elongated receiving channel 38 is preferably semi-circular at the bottom thereof, and has a diameter slightly greater than that of the blades. The tolerance between the edge of the helical blades 45 and the interior side walls of the channel is in the range of about 1/8 inch to about 1/4 inch. Such tolerance is sufficiently small to enable the auger to transport substantially all
10 the deposited solids to the collection basin, while being sufficiently large to prevent interfering contact of the blade with the walls during operation.

A plurality of bearings 47 are spaced apart along the receiving channel 38 for rotational support thereof (FIGURES 3 and 4). Further, while the helical blades 45
15 terminate at the mouth or entrance of the delivery portion 40 into the collection basin, for delivery of the transported solid contaminants to the separation assembly 26, the distal end of the shaft continues through the collection basin where it is supported by end bearing 47'. At this end is the drive mechanism 43 which is preferably provided by a chain drive and drive motor 50. The drive motor 50, in one example, is a 1 hp
20 electric motor.

Referring now to FIGURES 3, 4 and 6, in accordance with the present invention, the separation assembly 26 communicates with the collection basin 25 to remove and separate the collected solid contaminants from the slurry of run-off washing fluids
25 and the transported heavier density solid contaminants therein, while substantially maintaining the run-off washing fluid in the collection basin 25. In particular, the separation assembly 26 includes a drag conveyor device 51 having a separation station 52 thereof immersed in the slurry of run-off washing fluid and run-off high solids contaminants transported to the collection basin 25 (via the auger member 42),
30 and adapted to separate and displace the removed, higher density solids contaminant from the slurry. The separation assembly 26 further includes a discarding station 53, spaced-apart from the separation station 52, which is adapted to discard the collected portion of the deposited high solid contaminants from the drag conveyor. Further, the discarding station 53 is positioned at a vertical elevation above the separation station

52. Since the discarding station 53 is elevated above the separation station 52 and the slurry of the collection basin 25, the separated contaminants are dragged to the discarding station 53 while the run-off washing fluid and remaining slurry are maintained in the collection basin 25. Accordingly, the separated higher density solid
5 contaminants are permanently removed from the slurry in the collection basin, and hence, the closed-loop pressure washing system. This cycle is repeated until substantially all the higher density solid contaminants are eventually removed in this manner.

10 In one specific embodiment, the separation assembly 26 includes a drag conveyor device 51 having a separation station thereof immersed in the slurry of run-off washing fluid and run-off high solids contaminants transported to the collection basin 25 (via the auger member 42), and adapted to separate the higher density solid contaminants from the slurry. The separation assembly 26 further includes a
15 discarding station 53 spaced-apart from, and at a vertical elevation above the separation station 52. The discarding station 53 is adapted to discard the separated and dragged higher density solid contaminants from the drag conveyor to a discard site.

20 As best viewed in FIGURES 4 and 5, the drag conveyor device 51 includes a frame assembly supporting a central chain drive system 56 including a link chain device 57 mounted about a plurality of sprockets 58 spaced-apart along the frame assembly. The chain drive system 56 further includes a motor drive 59 coupled to an upper drive sprocket 58' that drives the link chain device about the sprockets 58, and continuously
25 along a drive path from the separation station 52 to the discarding station 53, and back to the separation station. A plurality of drag weirs 60 are disposed along the link chain device 57 in a spaced-apart manner along the drive path. Each drag weir 60 is disposed transversely along the chain device 57 in a manner such that the planar face of each weir 60 is oriented substantially perpendicular to the direction of movement
30 along the drive path. As viewed, in one example, the drag weirs are centrally mounted to the chain device 57 in a conventional manner.

In one alternative embodiment, to facilitate guidance and positioning of each weir 60 as they are dragged by the drive chain device 57, the opposed edges thereof may

include end guides (not shown) that engage associated guide rails (not shown) of the frame assembly that extend along the drive path. Accordingly, the guide rails, the end guides and the link chain device would cooperate maintain the planar face of each weir 60 substantially perpendicular to the direction of movement along the drive path
5 smoothly and continuously between the separation station and the discarding station.

A sleeve member 61 encloses the chain drive device 57, weirs 60 and frame assembly between the separation station 52 and the discarding station 53. This sleeve member not only provides a measure of safety from the moving conveyor components, but
10 also provides a bottom support surface 62 that cooperates with the bottom edge 63 of the drag weirs 60 to facilitate collection of the separated higher density solid contaminants. Similarly, the adjoining interior sidewalls 65 are oriented and sized cooperate opposed side edges 66 of the drag weirs 60 to separate and move the collected higher density solid contaminants along the bottom support surface 62 of the
15 sleeve member from the separation station 52 to the discarding station 53. Accordingly, the interior bottom support surface 62 and adjoining interior side walls 65 of the sleeve member 61 are adapted and sized for sliding receipt of the drag weir 60 therethrough.

20 The sleeve member 61 includes an opened mouth portion 67 at the separation station 52 of the that enables the drag weirs 60 to enter the collection basin 25 as they round the bottom sprocket 58". At the separation station 52 (FIGURES 3 and 4), the drive shaft 46 of the auger member extends through the drive chain device 57 near the bottom sprocket. Accordingly, the drive path of the weirs extend around the drive
25 shaft 46 so that the delivery portion 40 of the collection device delivers the collected and transported solid contaminants into the mouth portion 67 of the separation station 52. As weirs 60 enter the separation station 52 at the mouth portion 67, they each scoop a portion of these delivered higher density solid contaminants.

30 The drag weirs are preferably composed of steel or plastic, and have leading edges 63 and side edges 66 that are sized and dimensioned to be slidingly received within the sleeve with a tolerance with the interior side walls 65 of the sleeve member 61 in the range of about 1/8 inch to about 1/2 inch. This tolerance is sufficiently small to enable scooping, dragging and retaining of the separated higher density solid

contaminants through the sleeve member, while enabling the run-off washing fluid to pass therebetween so that the same is maintained in the collection basin 25.

As the separated solid contaminants from the collection basin 25 are dragged up the
5 bottom support surface 62 of the sleeve member, they solids are deposited through the
discarding station. Similar to the separation station 52, the discarding station 53
provides a discard opening 68 along the bottom support surface 62 upon which the
drag weirs 60 are moved through as they are driven along the drive path. As the drag
weirs 60 pass through the discard opening 68, gravity causes the dragged solid
10 contaminants to fall therethrough. The discard region 27 may include a removable
contaminant collection bin 70 placed below the discard opening 68 to enable gravity
flow collection of the discarded contaminants.

It will be appreciated that the collection bin can be any collection device such as a
15 trash can or even a wheelbarrow. It will further be understood that while only one
such contaminant separation assembly is described in detail, other contaminant
separators may be applied to separate the higher density solid contaminants from the
slurry in the collection basin such as augers, vibratory conveyors, belt conveyors or
bucket elevators.

20 Referring back to FIGURES 3 and 6, a heavy duty sump pump 71 is disposed in a
sump tub 72 to transport the collected run-off washing fluid in the collection basin 25
to the clarifying reservoir 28. The sump tub 72, thus, is in fluid communication with
the collection basin for fluid access to the collected washing fluids. A coarse mesh
25 filter 73 or the like may be provided between the collection basin 25 and the sump tub
72 to prevent larger, higher density solid contaminants (e.g., rocks) from passing
through the intake of the sump pump 71 which could be damaging. However,
suspended middle weight and light weight contaminants will be passed through the
sump pump 71 and into the clarifying reservoir 28. A pump line 75 or hose fluidly
30 couples the sump pump 71 to a delivery inlet port 76 of the clarifying reservoir 28 for
delivery of the pumped run-off washing fluid into an interior cavity 74 of the
reservoir. A one-way check valve (not shown) prevents flow back from the clarifying
reservoir to the collection basin 25.

Depending upon the quantity or flow volume of the run-off washing fluids into the collection basin 25 from the support surface 22, the pumping capacity of the sump pump 71 can be selected accordingly. Moreover, the sump pump can be configured to automatically operate during the operation of the water cannon, the pressure washer or transport device 41. In one specific example, the sump pump 71 may be provided by Zoeller Pump Co. of Louisville, KY, Model No. M137, which has the pump capacity in the range of about 65 gal/min to about 95 gal/min.

Once the sump pump 71 delivers the run-off washing fluid to the clarifying reservoir 28 through the delivery inlet port 76, the stored washing fluids may be applied for two purposes: providing semi-filtered washing fluid to the high volume water cannon 30, as well as providing fully-filtered washing fluid to the pressure washing 31.

As shown in FIGURE 6, the delivery inlet port 76 of the clarifying reservoir 28 delivers the pumped run-off washing fluids into a delivery portion of the reservoir interior cavity 74 located at one end thereof. To facilitate further settling and separation of the middle weight and lighter weight contaminants in the pumped run-off washing fluids, a plurality of baffles 78 are disposed in an interior cavity 74 that require the deposited fluids to flow through the baffles from one end of the reservoir to the opposite end thereof. These baffles are aligned in an array, and are configured to channel the fluids through the baffles 78 along the direction of arrows 80. The baffles facilitate settling and silting of the medium weight density contaminants into a first settling portion 81 of the clarifying reservoir 28.

To initially collect these separated contaminants, the first settling portion 81 of the clarifying reservoir is conical-shaped and is positioned below an upstream first portion of the baffles 78. The conical narrowing tapers to a small diameter mouth portion 83 (preferably about 4 inches in diameter) wherein the contaminants settle from suspension after passing through the baffles 78. A first valve device 82 having a large bore opening is preferably positioned at the mouth portion 83 to enable selective venting of the collected contaminants therethrough into a disposable filter bag or the like positioned on the other side. Preferably, the first valve device 82 is provided by a rapidly opening, ball valve or pneumatically assisted valve which may be periodically

operated manually or automatically when the separated solid contaminants sufficiently accumulate at the conical bottom portion.

5 Applying the pressure head of the fluids in the clarifying reservoir, upon opening of the first valve device 82, the accumulated and settled contaminants in the conical first settling portion 81 are periodically flushed from the reservoir into the filter bag or other container. The filtered solids are retained in the filter bag or container for appropriate disposal. The draining of the sludge or lighter weight solids from the bottom of the conical settling portion 81 can be automated which reduces manual
10 maintenance and operation, and ensures the periodic removal therefrom.

Alternatively, the first valve device 82 may be fluid coupled to a delivery hose 85, for selective delivery to a remotely positioned container or the like. In still other embodiments, the outlet of the delivery hose may simply redeliver the settled
15 contaminants from the conical settling portion 81 back into the receiving channel 38 of the collection device for recycling through the separation assembly 26.

In still other specific embodiments, the clarifying reservoir 28 may include a second conical settling portion 86 positioned adjacent to and downstream from the first
20 conical settling portion 81. Similar to the first conical settling portion 81, the bottom wall tapers inwardly toward a small diameter mouth portion 87 where a second valve device 88 is seated. Since this second conical settling portion 86 is positioned further downstream relative the flow through array of baffles 78, the quantity of deposited silting and settling contaminants is significantly less. Thus, the periodic flushing of
25 this cone would be performed less frequently.

In yet another specific embodiment, the second valve device 88 could be fluidly coupled, via a flush line 90 (FIGURE 1), to an upstream end of the receiving channel 38. This channel flush can be automated which reduces manual maintenance and
30 operation, and ensures the periodic sludge removal from the second settling cone as well. Using the vertical elevation of the clarifying reservoir 28, about 8 feet to about 10 feet above the receiving channel 38, a pressure head in the range of about 3 psi to about 4 psi is produced to flush the solid contaminants from the receiving channel 38 and into the collection basin 25.

In accordance with the present invention, as mentioned, the clarifying reservoir 28 provides a source of semi-filtered washing fluids for a high volume water cannon 30. As illustrated in FIGURES 1 and 6, the clarifying reservoir 28 includes a cannon outlet port 91 to feeds the semi-filtered washing fluids contained in the reservoir to the high volume water cannon 30. In one configuration shown, the cannon outlet port 91 is fluidly coupled to the water cannon 30 through a hose or cannon fluid line 92 that provides a fluid communication passageway. One end of the fluid line 92 is fluidly coupled to the cannon outlet port 91 at an exterior side wall 93 of the clarifying reservoir 28 that is preferably positioned centrally on the side wall. The location of this outlet port enables fluids to be drawn from a location intermediate the clarifying reservoir side wall 93 which is below the level of the light weight contaminants that have floated to the top of the contained fluids in the clarifying reservoir. Further, this intermediate position is above the heavy and middle weight contaminants settling out of the contained fluids therein.

The high volume water cannon 30 includes a cannon pump 95 having an inlet side coupled to the outlet of the fluid line 92, and an outlet side device to a coarse cannon filter pack 96. In turn, the cannon filter pack 96 is fluidly coupled to a delivery pressure line 97 having a cannon nozzle 98 at the opposite end thereof for delivery of the semi-filtered washing fluids from the water cannon 30. These water cannon pumps 95, such as those provided by Scott Pump of Cedarburg, WI, Model No. VFE50, are capable of expelling fluids in the range of about 40 gal/min to about 80 gal/min, that provides a low spray in the range of about 60 psi to about 70 psi. For example, in the present application, the ejection of the semi-filtered washing fluid from the cannon nozzle 98 of a pressure line 97 fluidly coupled to the outlet of the coarse filter pack 96 is about sixty (60) gal/min at a velocity of about 80 ft/sec, and a pressure drop across the cannon nozzle of about 50 psi. Accordingly, this coarse washer provides significant capacity to impinge large volumes of fluids against the vehicle at a significant force for contaminant removal.

The cannon filter pack 96 includes a conventional two-hundred (200) micron bag filter that provides relatively coarse filtering of the semi-filtered washing fluid before ejection from the cannon nozzle 98. The semi-filtered washing fluid, preferably

water, contains dissolved solids which appears as dirty water. However, this solution is sufficient for first stage washing again if desired.

In another specific configuration, the water cannon may be mounted directly to the side wall 93 of the clarifying reservoir, thereby eliminating the need for the intermediate fluid line 92. This arrangement is further advantageous in that the overall footprint of the washing assembly is reduced since a separate area need not be provided for the relatively large cannon pump 95.

Referring back to FIGURE 6, the clarifying reservoir 28 includes a cleaner water chamber 100 positioned at an end of the interior cavity 74 of the reservoir opposite the inlet port 76 from the sump tub 72. This cleaner water chamber 100 provides a reservoir of yet more filtered washing fluid for use with a rinse wash pressure washer 31. By providing a sealed, interior over weir 99 in the interior cavity, the cleaner water chamber 100 is formed wherein the flow of washing fluids over the over weir 99 and into chamber (arrow 104). Accordingly, the middle weight density contaminants will be more fully filtered out of the fluids in this compartment, and will not be passed to the more sensitive pressure washers which may be damaged or clogged by such additional contaminants.

The spray pressure washer 31, on the other hand, draws fluid from the clean water reservoir and further through more stringent filtering than is necessary for the high volume water cannon. In fact, due in-part to the sensitive nature of the componentry of the pressure washer 31, the filtering is performed prior to coupling to the pressure washer rather than after the pump as in the case with the water cannon. As best viewed in FIGURES 1 and 6, another side wall 101 of the clarifying reservoir 28 includes a delivery outlet port 102 that is fluid coupled to the clean water chamber 100. A fluid line 103 includes one end fluidly coupled to the clean water chamber 100, and an opposite outlet end fluidly coupled to a delivery pump 105. Similar to the delivery port for the water cannon, the outlet port 102 is positioned below the fluid level in the clean water chamber to reduce or eliminate delivery of the lighter weight contaminants to the pressure washer.

The delivery pump 105, by way of example a Teel Pump of Northbrook, IL, Model No. 4RJ89, forces the water through a pressure washer filter pack 106 or series of filter packs to deliver filtered washing fluid to a pressure washer 31. In turn, the conventional pressure washer delivers the pressurized, filtered washing fluid, via a pressure pump, to a pressure wand 107. These spray pressure washing devices 31 provide a mechanism to pressure wash the object using a conventional pressure wand 107 and a compatible spray nozzle 108. The pressure pump can be provided any conventional high pressure pump assembly, and is preferably capable of delivering a variable pressure for a selective pressure spray application. One such conventional pressure pump, for example, is that provided by WANNER, Model No. MD3EABJSSECA, which is capable of providing a low pressure spray in the range of about 50 psi and a high pressure spray in the range of about 3000 psi

A fresh water rinse can be provided for final rinsing of the equipment, and can be added manually or automatically when washing fluid in the clarifying reservoir becomes too low. On the other end, since the system operates as a fixed volume, closed loop system, too much fluid in the separation tank will require removal before an overflow situation occurs. Thus, a safety overflow can be provided to dispense overflow fluid to a drain or waste source. This may simply be performed using the valve devices of the settling cones.

Since the clarifying reservoir promotes separation of both the heavy and medium weight (density) contaminants from the washing fluids, the lighter density contaminants (e.g., oils) will float to the top of the washing fluids in the clarifying reservoir. As the washing fluids flow over the over weir 60 and into the cleaner water chamber, the lighter weight contaminants will be trapped by the walls defining the cleaner water chamber. To remove these lighter weight contaminants, if oils are being washed off without soap, a conventional mechanical oil skimming device can be located at the top of the cleaner water chamber to remove the free floating oil. The contaminants can then be collected and directed into a container for proper discarding. However, if the oils are intensely mechanically emulsified, oleophilic surfaces can be used to reclaim the majority of the oils. If the oils are chemically emulsified, a specially designed clay or carbon filter is used to remove the oils below the sewer

districts acceptance levels. Any time oils are being washed, it is prudent to discharge the water through an organo-clay filter prior to being dumped to sewer.

5 There are specific soaps called "quick release soaps". When these soaps are used to wash items covered with oils, the quick release soaps retain the oils in solution as long as the fluid is in motion. When the oil emulsified water reaches a quiet location for several minutes, the majority of the oil is released and collects on the surface of the water. This quiet location also allows the solids to separate from the water by gravity. Because 100% oil release cannot be guaranteed in the time available in the
10 system, it is always prudent to run the water through a clay or carbon filter designed to remove oils from the water stream prior to disposal down the sewer.

In yet other configurations, the washing apparatus may also include an ozonation system (not shown) to ozonate the process fluid in the clarifying reservoir 28. As set
15 forth in U.S. Patent No. 5,785,067, which is incorporated by reference, ozonation is highly beneficial since it is highly oxidizing, and will attack substantially any contamination in the water. Briefly, the ozonation system includes a recirculation pump that draws process fluid from the clean water reservoir 100 through a screened inlet end and into recirculation line. Once the process fluid is drawn into the
20 recirculation line from the recirculation pump, the process fluid flows through a gas-liquid mixing device, such as a venturi-type injector. The injector is further coupled to an ozone generator, such as the model CS-1200 available commercially from Clearwater Technologies which is capable of generating 0.25 grams of ozone per hour. The ozonated water is then returned to the clarifying reservoir 28, via an
25 recirculation line. In this arrangement, the ozonated water is caused to directly attack the bacteria and associated odors from the run-off process fluid in the collection compartment and in the separation compartment.

In another aspect of the present invention, as best shown in FIGURES 1, 7 and 8, a
30 high load capacity closed-loop washing system 20 is provided for the support of and contaminant removal from a substantially heavy load equipment such as loaders, trucks, tractors, etc. The system includes support platform 21 for supporting the heavy load object including a frame assembly 32 having fluid impervious upstanding peripheral side walls 110, 110' and 110'' and a fluid impervious support surface 22

extending atop the peripheral side walls 110 to collectively define an enclosed interior cavity therein. The support platform 21 including a flowable support material 111 curable into a relatively low density, high compressive strength material support enabling vertical support the heavy load object atop the support surface 22 while a washing fluid is flowed over the object to remove the high solids contaminant. The washing system 20, as shown in FIGURES 1 and 3 further includes a collection device 23 in flow communication with the support surface 22 which is adapted to collect the slurry of run-off washing fluid and run-off high solids contaminant from the support surface 22 in a collection basin 25. Lastly, the washing system provides a clarifying reservoir 28 in flow communication with the collection basin 25 that is configured to store run-off fluid therein for reuse back to the washing system. Accordingly, the support surface together with the frame assembly 32 and the curable support material 111, a relatively light-weight, solid support floor arrangement is constructed.

The support surface 22 provides a load bearing surface, and is preferably a solid metal plate material of about 1/4 inch to about 1/2 inch in thickness. Further, to facilitate sufficient traction, the support floor is constructed of diamond plate carbon steel which has been sandblasted, and surfaced with an epoxy paint. Large grained sand may be incorporated with the paint to enhance the non-skid work surface quality as well.

The upstanding peripheral side walls 110, 110', 110'' and 110''' of the frame assembly 32 are preferably composed of a substantially rigid, fluid impervious material, such as metal. For example, as viewed in FIGURES 7 and 8, the peripheral side wall may be composed of steel C-channels having a thickness in the range of about 1/4 inch to about 3/8 inch. These beams may be welded together with one another to form a rectangular shell structure. To add lateral stability, two lower cross beams 112 may be included, extending between the two opposed side wall beams 110' and 110''.

The frame assembly 32 preferably includes a bottom support surface 113 upon which the side wall beams 110, 110', 110'' and 110''', as well as the support beams are situated atop. This bottom support surface 113 includes a foot print similar to that of the top support surface 22 which both mount to the edges of the side wall beams.

Collectively, upon mounting of these support surfaces 22, 113 peripherally to the side wall beams, the enclosed interior cavity is formed therein.

5 The flowable support material 111 placed in the interior cavity is preferably provided by a relatively low density, high compressive strength material support enabling vertical support the heavy load object atop. One such flowable composition is provided by a high strength cellular materials such as foamed concrete. Upon curing, this cellular material provides excellent compressive strength to weight ratio, being in the range of about 500 ft. to 1500 ft. This is due in part to the fact that such foamed
10 concrete per volume is 70% air.

To place the flowable support material 111 in the interior cavity of the support platform 21, an injection port 115 is provided in beam 110'. This port may be provided in one of the side wall beams or in the top support surface 22. A vent port
15 may also be included as well to provide an air vent as the flowable support material displaces the air. Using delivery lines, the foamed concrete is injected into the interior cavity.

Once the foamed concrete cures, a relatively low density, high compressive strength
20 material support fills the interior cavity, enabling the support platform to support heavy loads object atop. For example, such structures may be capable of sustaining weights in the range of about 100 lbs/in² to 400 lbs/in².

While this invention has been described in terms of several preferred embodiments,
25 there are alterations, permutations, and equivalents which fall within the scope of this invention. It is therefore intended that the following appended claims be interpreted as including all such alterations, permutations, and equivalents as fall within the true spirit and scope of the present invention.

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